The Moral Impact of Studying Science

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Abstract

Science and religion are most usually compared on epistemic grounds: what do they tell us about the natural world and what methods do they use to determine those truths? The suggestion here is that the two fields should be compared on moral grounds: how do scientific and religious experiences affect the way a person lives his or her life? A hypothesis is presented in this vein: engaging in scientific work or education alters a person's moral outlook on everyday matters. In this chapter, I articulate and motivate this claim by framing it against both theological and philosophical debate. I explore how it might be tested as a claim in moral psychology. The resulting vision presented here is of science and religion engaged in dialogue—at times necessarily embroiled—not only about the nature of the world, but regarding how best we navigate our way in it.

1. The Problem of Polarisation

In his 1989 Gifford lectures, *Religion in an Age of Science,* Ian Barbour presented a categorisation of theories that was to become the standard in the field of science and religion: a theory might portray the relationship between science and religion as one of conflict, independence, dialogue or integration (1990). Barbour's purpose was to give an overview of the prominent positions of the time in order to create a backdrop for his own narrative, which contained elements of both dialogue and integration. For almost thirty years, the resulting four-fold classification has set the scene for further discussion; it remains the prominent meta-theory in the field, despite acknowledgement of its weaknesses and suggestions for modification, clarification and alternative models, scholarship which has been both

summarised and enriched by Mikael Stenmark (2004). One widely accepted criticism of Barbour's classification is its epistemic bias: the relationship between science and religion is only analysed by comparing the truth claims made by each (Cantor and Kenny, 2001; Evans and Evans, 2008). Because the generation of knowledge is plausibly a more complete description of science than of religion, the concern is that the resulting classification unfairly ignores the many other roles that religion plays in society, including its rituals, prayers and ceremonies. Barbour's work itself heeds the richness of religious experience; the problem is usually located in the influence and application of his classification. John Evans and Michael Evans have gone further, arguing that an epistemological focus has permeated Western academic thought in its entirety, including the entire field of sociology, long before Barbour's contribution to the debate regarding science and religion (2008).

The criticism is true as far as it goes, but instead of clarifying and improving our understanding of the relationship between science and religion, it exacerbates what may in fact be a more pressing issue resulting from the hold of Barbour's work upon the field. Accepting the existence of non-epistemic roles for religion in society provides reasons for holding on to religion in the face of conflict with science, but it only does so by emphasising a division of labour between the two. If we suppose that science (and only science) deals with metaphysical truth whereas religion (and only religion) deals with moral truth, there is much less space for the two fields to interact. This results in a polarisation of the options available, encouraging either theories of conflict or those of independence. A prominent view that rose in influence in the decade after Barbour's work, for example, was the hypothesis that that science and religion, if pursued properly, are independent domains of knowledge (Gould, 1999).

For Barbour himself, the purpose of his classification was to prepare for the consideration and development of positive narratives about the relationship between science

and religion. Given this aim, its greatest failure would be the encouragement of viewpoints of independence and conflict at the expense of those of dialogue and integration. Although the literature shows that most scholars in the field assume that science and religion can—and should—be in dialogue, the community also acknowledges that this viewpoint is not shared in wider academic and public circles. As Colin Russell puts it, the existence of conflict between science and religion has been "unconsciously assimilated as part of the growing wisdom of our day" (2002, p. 10). Amidst growing concerns of how the science/religion debate is perceived and reflected in public spaces, most particularly schools, the most pressing concern is not merely that Barbour's classification does not depict the logical space in which theories can exist sufficiently accurately—which is, after all, to be expected from an early and pioneering systematisation of the field—but that, as a result of its inherent simplification, it fails to achieve its ultimate purpose, to encourage positive narratives about the interaction between science and religion.

Despite his own intentions, Barbour's classification has perhaps itself encouraged polarisation of the field because there lies a deep assumption about the division of labour within it. This is most clearly seen in his examples of positive interaction between science and religion. The communication between the fields is largely one-directional: scientific research papers land on the desks of theologians for them to work into a natural theology, systematic synthesis or wider metaphysics. Scientific progress, on the other hand, does not need the resulting worldview to be fed back to the laboratory: Barbour acknowledges that scientists need not raise wider questions about the order of the universe in the course of their work (1990). This means that the dialogue that is identified does not occur in the very midst of scientific practice, but at its outskirts. From the outset, Barbour's vision of dialogue was not of the most deeply entwined interaction between science and religion.

It is in the application and use of Barbour's classification, however, that the problem is greatest. Its four categories can too easily be unwittingly treated as mutually exclusive. Making this error forces a student, once encountering any conflict between science and religion, to choose between a position of conflict or of independence. Yet, in many areas of life, dialogue is most critical exactly when and where conflict exists. Mikael Stenmark's alternative classification thus has an important advantage over Barbour's: Stenmark gave less prominence to the factor of conflict when distinguishing the ways in which science and religion may relate (2004). He was careful to ensure that the existence of conflict between science and religion does not necessarily lead to the view that the fields are irreconcilable. Although Stenmark's classification is more sophisticated than Barbour's, however, we may begin to suspect that it is the very concept of a classification that is the source of the problem of polarisation. If our real concern is the development and portrayal of positive narratives regarding the interaction between science and religion, perhaps our best course of action is to get on with exactly that. I pause before doing so only to argue that this starting point can (and should) be accepted by believers and non-believers alike.

2. The Unimportance of Conflict

The concern that public opinion is polarised into positions of conflict or independence is most usually raised by those with religious affiliations, but there are many reasons to bring an atheist to accept that dialogue is possible and desirable between the two fields, even if he or she believes them to be in insurmountable epistemic conflict. In the first place, it seems a reasonable position to take, if one accepts the widely acknowledged point that Barbour's classification is, understandably, philosophically unsophisticated (De Cruz, 2017; Stenmark, 2004). It won't do to close off debate because of the existence, in some quarters, of conflict. Given that there are profound conflicts between different sciences (or religions), between

parts of the same science (or religion), between members of the same laboratory (or place of worship), it would be remarkable to find an absence of conflict between science and religion as a whole. Stenmark is right: conflict isn't so important in determining the relationship between science and religion. A humble atheist might also accept Alain de Botton's argument that there is much for non-believers to learn and take from religious practices, because there are many elements of religion which people find helpful and alluring (2012). The atheist earns the title 'humble' by respecting public opinion. Such humility is called for because secularisation has not spread as rapidly nor as globally as expected by the early sociologists of the twentieth century (Stark, 2015). Whether wanting to restrict it or promote it, secularisation thus demands public engagement about science from all sides. Thirdly and finally, there is a growing concern that public acceptance of the conflict thesis deters the religiously minded from studying science. This is, indeed, one of the reasons for the 2009 founding of the Learning About Science and Religion (LASAR) project. Enthusing young people about science, regardless of their religious affiliations, is something we should all be concerned with.

Both atheist and believer should be troubled then, if the epistemic bias and simplicity of Barbour's classification has encouraged a polarisation of public views. Criticisms have failed to keep this, the ultimate purpose of Barbour's work, in mind: they do not explain the failure of the classification to encourage narratives of rich, two-way communication. I have suggested that this failure is, at least in part, a result of assuming a sharp division of labour between science and religion. For many, the assumption that science and religion have very different work to do is a fair one. A difference must be presumed, after all, for the fields to be compared at all. But we should perhaps wonder why we are so concerned to compare the two fields, if our real purpose is to communicate. The existence of conflict is to be expected and makes the need for interaction between the fields more urgent, not less. If we accept that

dialogue is possible and desirable, the debate regarding science and religion should be extended beyond classification, and be reoriented to deepen and enrich dialogue where it exists and to encourage it where it does not. It is against this background that I propose to entertain the idea that science contributes more than a collection of facts to moral decision-making. The criticism of epistemic bias made of Barbour's work can be taken one step further: instead of merely pointing out the neglect of religious experiences such as ritual, prayer and ceremony, we can go on to compare the moral consequences of participating in such activities with the moral consequences of participating in science. The suggestion here is that science and religion can conflict on moral grounds: *engaging in scientific practice and education alters a person's everyday moral outlook.*

Although it is true that recent debate has not sufficiently acknowledged the importance of religious experience, it has perhaps acknowledged scientific experience even less. It has been assumed that scientists, *qua* scientists, have nothing to add to moral decision-making other than facts. Exploring an alternative hypothesis promises to open new ground for dialogue between science and religion. I have argued so far that atheists and non-believers alike should bypass the question of classification and take the possibility of dialogue as a starting point for the debate regarding the relationship between science and religion. Whether this can be done by approaching the debate on moral terms, however, remains to be seen. The idea that science doesn't just raise moral questions, but takes part in answering them contrasts sharply with the common-sense view that science tells us what we can do, but not what we should do. We shall see that historic attempts to deliver an ethics from science have largely been unsuccessful. I turn now to distinguish the hypothesis at hand from these failed projects of the past and, by doing so, to articulate it more clearly.

3. A Return to an Ethics of Science

More than thirty years ago, Bernard Williams rallied against the apparent goal of modern philosophers to generate codified systems of morality, taking particular aim at Kantian ethics and utilitarianism (1985). In a perfectly codified system, the role of moral reasoning appears be restricted to the choice of initial axioms, from which all else follows by the application of logic. The principal variants of utilitarianism have customarily been interpreted in this way, resulting in a theory that has felt, even by its first critics, barren, dry and soulless (Macaulay, 1860). Some utilitarian thinkers have gone further, rejecting the need for any moral kick-start to their system: J. S. Mill (1861) believed that humans ought to strive to maximise happiness because it was in their nature to desire happiness; today, Sam Harris (2004) takes a similar view when he argues that the right thing to do can be worked out entirely from fact. In its most extreme form, then—as exemplified by the logical positivists—the aim of deriving an ethics from science goes as far as denying that there is any such thing as moral knowledge at all. Public intuition, on the other hand, has been on Williams' side, resistant to the idea of grounding morality in science. The commonsense view has been that science reveals how things are, but we must then, independently of science, decide what to do about those facts. For many philosophers, the commonsense view is supported by a compelling philosophical argument that is famously traced back to David Hume (1739). The *naturalistic fallacy* is a modern presentation of Hume's argument: it is a mistake to derive moral principles (about what there ought to be) from factual ones (about what there is). Set against the naturalistic fallacy, any attempt to derive ethics from science appears naïve, possibly including the hypothesis presented here that scientific experience alters a person's moral outlook.

On the other hand, the hypothesis can appear entirely trivial. We take it for granted that experiences—including education of all kinds—bring about changes to our characters. If this is to mean very much, it should at least mean that experiences affect a person's reactions

when faced with ordinary decisions that have a moral flavour. As absurd as it may seem to generate ethics from science, it may seem equally absurd to assume that study merely adds to a person's knowledge, as if a person remains exactly as they were before learning, but with access to additional information in their memory. In the last 60 years, a series of philosophical arguments for the subjective nature of science has challenged the correctness of making a sharp distinction between what a person knows to be true and what a person believes to be right (Barnes and Bloor, 1982; Kuhn, 1962; Longino, 1990). In particular, philosophers have suggested that scientists must turn to values, in addition to factual data, when making a choice between two competing theories (Kuhn, 1962). They have also suggested that values are necessary to interpret scientific data and reach scientific conclusions (Douglas, 2009). Note that philosophical work in this vein has identified particular situations where values play a role in scientific work and this is what philosophers are referring to when they report that, "Science is subjective." A statement of this kind should not immediately be taken to mean, therefore, that science is irrational, that values permeate all areas of the sciences equally and universally, or that science is subjective to the same extent or in similar ways to other fields.

Against the philosophical literature of recent times, then, the hypothesis that science alters moral outlook is an unsurprising one. However, the philosophical arguments to date have emphasised the ways in which science relies upon values, and thus challenged the idea that science has a special status as the primary source of reliable and objective knowledge. The blurring of lines between science and religion has yet to be explored in the opposite direction: if values play a more profound role in generating facts, might not facts play a more profound role in generating values? In this way, the hypothesis that science alters moral values is a logical step forward from the current philosophical discussion regarding the relationship between fact and value.

It nevertheless remains to distinguish the hypothesis that science alters moral outlook from its failed (and extreme) predecessors in the history of ethics. I do so in three ways, by emphasising: the empirical nature of the hypothesis; its mundane focus; and its attention to change. In the first place, there is no derivation here of statements of value from statements of fact, as Hume argued was impossible. It is not suggested that a logical connection exists between the two. The statement 'we should not eat meat' cannot be derived from our scientific theories. Yet, it is plausible that certain scientific practices increase (or decrease) the chances that a person becomes vegetarian. If those scientific practices are widespread, it will have an impact on the moral outlook of our society. An ethics resulting from science need not, then, be a top-down, logical system of morals. This means that the causal connections between scientific experience and moral outlook may be difficult, even with hindsight, to explain. It has been common in moral psychology to make this assumption since Simone Schnall *et al.* reported that being asked to wash your hands before entering an interview room affects your moral judgements during the interview (2008). Even in cases where the causal connection is plausible, it remains an empirical result that requires testing to demonstrate. It is possible, for example, to present plausible explanations of why conducting medical research on rats is more likely to bring a scientist to vegetarianism, if research were to reveal this causal connection. It is equally possible to provide plausible explanations of why conducting medical research on rats has the opposite effect. The rationale takes secondary place, after empirical research has ascertained the conclusion to be drawn.

Secondly, the focus here is on the moral decisions that are met with when going about the ordinary business of living. Should a lover who no longer wishes to be in a relationship wait until her partner has completed a course of chemotherapy before revealing her feelings? Should the able-bodied childminder leave the buggy outside the toilet cubicle or go instead with the buggy into the disabled cubicle? Should a parent allow a five-year-old to become a

vegan? Situations of this kind cannot be easily solved by logic because they are not simple exemplifications of general moral principles. Furthermore, conducting empirical research into the relationship between scientific experience and everyday moral outlook will not reveal high-level claims regarding how we should act. What is being sought is evidence of the impact of a particular scientific experience upon a particular aspect of a person's beliefs, inclinations, judgements, behaviours or dispositions, that are demonstrated in everyday life. (I generally use 'outlook' to avoid prioritising between these qualities and to thus avoid making assumptions regarding the metaphysics of mind; I also leave the question open regarding what counts as a scientific experience and do not claim that there is any profound or meaningful distinction between this and any other kind of experience.) There is no assumption made here about what characterises morally good behaviour, but it is assumed that we can distinguish moral decisions (in which we can respond more rightly or more wrongly) from non-moral ones (in which there is no right thing to do). A person's moral outlook is then understood to be the collection of their reactions when faced (possibly counterfactually) with such decisions.

Finally, the hypothesis is framed to consider *changes* to a person's moral outlook. From this perspective, there is no seeking of the ultimate source of morals. Because the focus is on everyday living, there cannot be a moral void into which science steps: we are forced to make these kinds of moral decisions by living our lives, and in doing so we demonstrate a moral outlook. As a result, even if scientific experience is found to alter morality, it is not the only generator of value.

The resulting claim is still a challenging one for some believers, especially for those who believe that their religious institution provides the only guidance on moral matters. But if a believer accepts that family, friends, and many other influences can help a person to live a better life, it is plausible that learning about the natural world may do so too. What is more,

there is no assumption here, as has been associated with historical attempts to derive ethics from science, that an alteration to morality brought about by science is necessarily an improvement. It is because of this that the hypothesis presented here provides a new platform for the debate between religion and science: once an effect of scientific (or religious) experience is revealed, it remains to be debated whether the change is desirable or not.

This sketch of how a modern ethics from science should differ from those of the past has implications for a theory of morals required to support it. It requires a moral philosophy that allows for progress in morality, that focusses on the mundane, that is open to many moral sources, that has an empirical aspect, and that looks to experience as well as belief. These are stringent and high demands to place upon a theory of morals and much philosophical work is yet to be done to provide such a framework. The philosophical motivation for doing so would be to take the argument for the subjective nature of science to its logical ends. In addition, there is a theological motivation for this work, to steer between the polarising position of conflict and independence in the science/religion debate and to encourage richer dialogue between the two fields. I see the primary purpose of this work, however, to be in education: how does the study of science impact upon the moral outlook of children? In the penultimate section of this chapter, Section 5, I assess the most relevant research completed in this area to date and explore how best it might be continued in the future. Before that, I reveal some evidence that indicates that bypassing the problem of polarisation may be more difficult than I have so far suggested.

4. Evidence of Changing Attitudes in Children

There is no assumption here that scientific experience is superior to religious experience for the development of a person's morality. Yet, it does challenge members of religious communities in a new and potentially difficult way, to open the debate on how we become

better people to sources other than religious authorities. On the face of it, the research envisaged does not answer the question of what it is to be good but, once goodness is agreed, how to go about embodying and implementing that goodness in everyday life. Because the many believers and non-believers alike, for example, can agree that it is a good thing to regularly donate to charity, a discovery of the kind that studying chemistry brings people to give more to charity than listening to sermons does would be worth analysis and debate. A fundamental disagreement between atheists and believers may well remain in the ensuing conversation regarding the ultimate source against which morality is measured. Those without religious commitments are more likely to assume that moral judgements can only be made by the lights of previous experience. From this perspective, scientific and religious experience may make an equal contribution towards our moral judgement. Those with religious commitments, however, are more likely to assume that they should, at least in part, assess the impact of scientific experience against moral requirements revealed through religious practice, tradition and teaching. From this perspective, science and religion cannot have an equal impact upon moral judgement. The religious community may sense a deeper and more threatening challenge here, then, to the priority of religion in matters of value.

The situation echoes, perhaps, the challenge felt, from the time of Thomas Kuhn's work onwards, by some scientists to the priority of science in matters of fact. As a result of Kuhn's work, it is more readily accepted by the philosophical community today that our commitment to the rationality of science is based on conviction. Indeed, Gary Gutting has argued that this no longer remains an argument, but is an example of knowledge secured by philosophers in the latter half of the twentieth century (2009). (This is not to say, as Gutting emphasises, that philosophers have concluded that science is irrational or based on personal prejudice.) I suggest that the growing appreciation for how science makes use of values has not reduced public confidence in the institutions of science. Similarly, I propose that

exploring its subjective aspects further, to consider the possibility that it generates values, need not reduce public confidence in the equally robust institutions of religion.

The persistence of public attitudes, however, casts doubt on the theological motivation for this work. I have suggested that viewing science as an influencer of values, and thus permitting the two fields to debate on a more equal footing regarding moral questions, will offset the unintended polarising consequence of Barbour's classification. One reason for thinking that this line of reasoning may be overly optimistic is that viewing science as a consumer of values does not appear to have a similar effect. The conflict thesis—the idea that science and religion are irreconcilable—remains strong, despite the increasing acceptance within the philosophical community—and possibly wider communities—that science has subjective elements.

My own experiences with undergraduates of philosophy of science over the last twenty years suggest that there has indeed been a growing acceptance in the UK of the subjectivity of science, although this has not obviously reduced the popularity of the conflict thesis. I have conducted a pilot study in two Cambridgeshire secondary schools to test this hypothesis further. It indicates that children today may indeed be more aware of the subjective nature of science than they were twenty years ago.

In 2015-2016 academic year, I administered a questionnaire to Year 7 students (aged 11 to 12) at a co-educational state secondary school (serving 1,400 students aged 11 to 18). I administered the same questionnaire in the 2016-2017 academic year to Year 8 students (aged 12 to 13) at a second co-educational state secondary school (serving 1,300 students aged 11 to 16). The "Large Scale Exploration of Pupils' Understanding of Nature of Science" questionnaire (LSE) was developed and validated by Joan Solomon, Linda Scott and Jon Duveen (1996). It consists of five multiple-choice items. The fifth item of the questionnaire (shown in Fig. 1) asks students why old scientific theories are replaced by new ones.

Solomon *et al.* presented four options for students to choose from and accepted three of these as adequate responses. An old theory might be replaced as a result of (a) newer technology, (b) new evidence, or (c) because people at different times have a different way of explaining. They took the fourth option, (d), that scientific theories are replaced when older experimental results are proved wrong by newer ones, to indicate a less developed view of scientific progress.

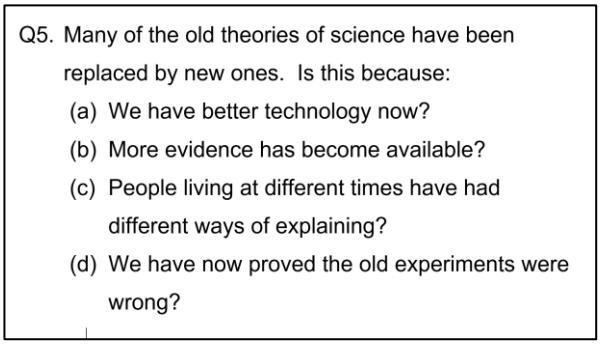

Fig. 1 Item 5 from the LSE questionnaire administered in 2016 and 2017 at two Cambridgeshire secondary schools, originally published by Solomon, Scott and Duveen (1996). Solomon *et al*. considered (a), (b) and (c) to be adequate responses to the question.

The item addresses one particular aspect of the subjectivity of science. In the first half of the twentieth century, logical positivists promoted an objective view of the progression of scientific theories: a clear-cut distinction was made between theories that had been falsified and those that had not; the decision to replace one by another was a purely logical one, that was (at least theoretically) computable. Students who select the fourth option (d) are demonstrating a viewpoint of this kind. In contrast, Thomas Kuhn, following a long line of others, argued that scientists do not choose theories in an algorithmic way (1962). Students with a more subjective view of science, along the lines of Kuhn's, are more likely to respond to this item with option (c). It should be noted, however, that the item does not address the role that values play in theory change directly and therefore we label option (d) as a 'more objective' view than option (c) with caution.

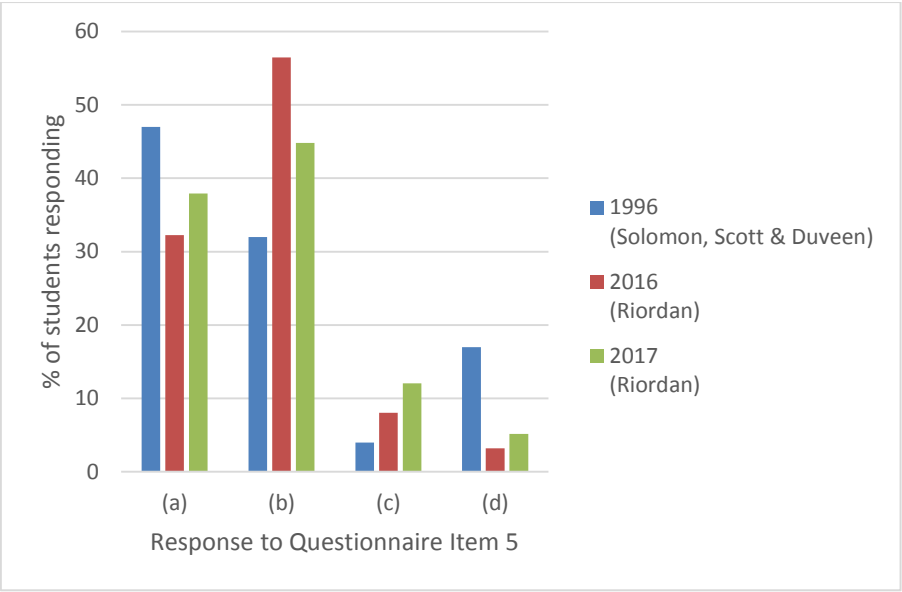

Fig. 2 The responses of students to the fifth item of the LSE (shown in Fig. 1). The comparison shows that students were more likely to give the answer (d) twenty years ago, indicating a more objective view of science. The numerical data from 1996 was interpreted from a graph (1996). When students in 2016 and 2017 responded with two options, each was given a score of 0.5.

Solomon and her colleagues administered the LSE to 126 British students in Year 8 in 1996. In 2016, I gave it to 31 students in Year 7; in 2017, I gave it to 30 students in Year 8. The results are shown in Fig. 2. They show a statistically significant decrease ($p < .001$) in the number of students opting for option (d) in the recent tests (4%) compared with the original test (17%). (The *p* value has been calculated by applying Pearson's chi-squared test.)

This is an intriguing result from a pilot study but one which cannot be readily generalised to a wider population. In particular, post-questionnaire interviews conducted with the Year 7 students demonstrated that these students held a much more nuanced understanding of science than had been captured by the LSE. These interviews therefore revealed the limitations of this research method. Indeed, since this questionnaire was developed there has been a growing understanding of the complexities of eliciting students' views on the nature of science; research has suggested that students' attitudes on this matter

are better elicited by open-ended methods (Lederman et al., 1998). This pilot study was restricted because it required data from the past, a more thorough study of children's current attitudes to the subjectivity of science would use improved elicitation tools.

Further research is also required to discover whether children who view science as more subjective are less likely to accept the conflict thesis. Perhaps the conflict thesis is becoming less entrenched in public thought as Russell took it to be in 2002. If so, we may be more optimistic about the growth of dialogue between science and religion and of the path I am advocating of how to move the science/religion debate beyond Barbour. It is also possible, however, that children are continuing to accept the conflict thesis despite (and even because of) their growing recognition of the more subjective elements of science. It may be easier to discard scientific ideas that disagree with one's own if science is too lazily labelled 'subjective'. Such a conclusion would cast doubt on the idea that recognising the similarities between science and religion can reduce the problem of polarisation.

5. Testing the Moral Impact of Scientific Education

So far, I have presented a claim—that practising or studying science alters a person's moral outlook—and attempted to make it at least palatable. I have situated this claim in an old debate regarding the conflict between science and religion, arguing that it provides a new platform for a richer dialogue. I have then articulated it against philosophical literature by distinguishing it from historical attempts to generate ethics from science. One way in which it differs to the claims of the philosophical literature (and requires a non-standard theory of morals) is that it is empirical in nature. It is, indeed, perhaps best tested as a claim of moral psychology, by administering of questionnaires and by conducting psychological tasks to measure scientific experience and moral outlook.

To date, the largest study broadly of the kind envisaged here was undertaken by Jean Decety and his colleagues, who investigated the correlation between the religiosity of households and the altruism of children in those households (2015). The study was of 1,170 children aged between 5 and 12 years, living in six countries (Canada, China, Jordan, Turkey, USA and South Africa). The religiosity of each child's household was measured by a questionnaire completed by parents and guardians. The altruism of the children was measured by psychological testing. A version of the 'dictator game' was played: the children were shown 30 stickers and allowed to choose 10 stickers to keep; on being informed that not everyone in their school could take part, they were then given the option of giving some of their stickers away. The study found a negative correlation between the religiousness of a child's household and the number of stickers the child donated. If a further correlation is then accepted between atheism and the practice of science, a conclusion can be drawn regarding the correlation between science and altruism that is very broadly of the kind under consideration here: scientific practice is positively correlated with altruistic behaviour.

The truth of this claim is not of immediate importance here. It is useful to us only as a point of comparison. There is no work that I know of that directly supports the hypothesis of this chapter. The work of Decety *et al.* differs from what is needed because it is not a causal claim of the kind we are looking for: the kindness of the children could not be attributed to their own scientific experience and education. Furthermore, this research did not measure changes in the children's kindness. Nevertheless, the psychological tasks of the kind used by Decety *et al.* would be suitable tools to compare the changes in moral outlook of students undertaking scientific study with those who are not. In the U.K., the most obvious point to administer such tests would be when students begin specialised two-year courses of study at the age of 16. Students with previously similar educational backgrounds are able at this point to take very different paths, some continuing with formal scientific education (following a

timetable that is mostly or entirely composed of science) and others dropping it entirely. The testing would then be retaken at the end of these specialised courses, providing the opportunity to discover if students' moral outlooks have diverged according to their choice of study.

Another difference with the work of Decety *et al.* is that we cannot yet identify what kinds of moral outlook we are interested to measure. We are considering the possibility of causal connections between scientific experience and morality that are not easily recognised and reasoned for. It is not clear at the beginning of the research, therefore, what psychological tests should be selected. Before psychological tests are conducted, it will be necessary to identify plausible relationships between areas of scientific study and moral outlook. This would perhaps best be achieved with a large-scale series of questionnaires designed to track the moral outlook of students through their specialised studies. Questionnaires of this kind have been designed and validated by researchers for similar purposes, most notably the Moral Foundations Questionnaire, developed by Jesse Graham, Jonathan Haidt, and Brian Nosek (2009). Adaptations could be made to tailor such questionnaires for teenagers and the specific moral decisions they face, covering topics of social media, relationships, animals, the environment and responsibility. The advantages of such an approach are that it is possible to address a wide range of topics and to reach many students, studying different sciences. On the other hand, it will not directly test students' moral outlook, but only their self-reported moral beliefs. Having identified potential causal connections, it would then be necessary to back up such research with smaller scale psychological testing.

6. A Vision of Dialogue on Non-Epistemic Grounds

I have attempted to articulate the hypothesis, in a way that avoids both triviality and absurdity, that engaging in scientific practice and education alters a person's everyday moral

outlook. I have considered how this claim can be tested empirically. Evidence that scientific experience impacts upon a person's morality would call for richer dialogue between two great pillars of society, those of science and religion. Such research has the potential, then, of taking the science/religion debate beyond Barbour's delineation of the field. Instead of classifying how science and religion can or should interact with each other, the vision presented here is of how we should get on with that interaction. In particular, it raises the question of how we live our lives above that of what there is in our world. It is, after all, a question for all of us, in all our capacities, to consider.

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